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Pluronic block copolymer-mediated interactions of organic compounds with noble metal nanoparticles for SERS analysis

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Abstract

The composite silver and gold nanoparticles (AgNPs and AuNPs) coated with nonionic amphiphilic block copolymers (Pluronics L121, F68, or F127) are prepared by their adsorption under critical micelle concentrations. It is found that Pluronics bind to the surface of metal NPs as a very thin film by the hydrophobic association through poly(propylene oxide) block of the copolymers. The modification increases the colloidal stability of NPs with increasing hydrophilic-lipophilic balance of Pluronics in the order of L121, F127, and F68. In order to investigate the potentials of polymer coated noble metal NPs as surface-enhanced Raman spectroscopy (SERS) probes, fluorescent dyes and doxorubicin are used as model compounds. It is found that Pluronic component promotes the adsorption of these compounds on the composite NPs resulting in a considerable increase of Raman signal. This effect is attributed to increased concentration of the analyte molecules on the composite surface due to the hydrophobic and charge-charge interactions between the analytes and the Pluronic coat, and the stabilization of NPs by poly(ethylene oxide) blocks. The copolymer coated AgNPs show higher SERS activity than the counterparts prepared with AuNPs. Among the prepared composites, the AgNPs modified with Pluronic F127 containing extended poly(propylene oxide) and poly(ethylene oxide) blocks exhibit maximal Raman activity using rhodamine 6G (Rh6G) with a EF of 9.04 - 106. The results show that the developed Pluronic-based SERS probes can be used for sensitive and selective analysis of organic analytes.

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